FAA | AVIATION NEWS

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FAA | AVIATION NEWS

F E D E R A L A V I A T I O N A G E N C Y

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COVER

FAA Administrator Halaby looks on as President Johnson presents medal to Mrs. Jerrie Mock, first woman pilot to fly solo around the world.

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The wings of the Douglas DC-7 used in the FAA-Flight Safety Foundation crash test crumbled as scheduled when the plane struck the man-made barriers before smashing into a small hill on the Arizona desert. The test yielded crash data never before obtainable. *(The Arizona Republic photo.)*

FAA STUDIES CRASH-TEST DATA...

Observers watched intently as a former DC-7 airliner slowly began moving down a narrow strip of Arizona desert runway, picking up speed faster than one would have thought possible in the aged craft. In little more than a minute and 5,000 feet later, it had completed a most heroic and scientific job of self-destruction.

Almost nine months in the making, the FAA-Flight Safety Foundation crash test promises to yield the most constructive and comprehensive data ever gathered on the problem of reducing crash fatalities. Considering the severity of the crash loads imposed on the airplane, the tests and experiments which had been set up in the cabin came through in surprisingly good shape.

The plane, bought by FAA for $29,000 from an aircraft salvage company, struck the man-made barriers with greater force than had been anticipated, with the result that the wreckage settled over an area of about 1,000 feet.

The idea was to simulate four real-life accidents in which

A nosegear "slipper," substituted for the nosewheel of the DC-7, held the plane to the track and tripped certain cameras just prior to impact.

The aircraft underwent a final inspection minutes before thundering down the 4,000-foot strip on the single rail leading to the barriers.

The work-weary DC-7, purchased for the salvage price of $29,000, is poised to make a final—if unique—scientific contribution to flight safety.

Operated by remote control, the plane held to its track and had only a moment of free flight before the final impact. *(The Arizona Republic photo.)*

The unexpectedly vigorous fire was mainly from burning oil inasmuch as the plane had only about 15 gallons of gasoline when it ignited.

. . . Most Aboard "Survive"

impact forces would be recorded to give information on passenger and crew seat strength and restraint systems, cargo restraints, and fuel containment systems. The crash followed the patterns desired.

Investigators were highly enthusiastic to discover that instrumentation on the basic aircraft structure, as well as the 16 wired dummies inside the cabin, functioned properly. Twelve on-board cameras and others mounted externally, which were correlated with the recording equipment, came through the test with little damage.

An on-site analysis disclosed that most of the dummies would have survived the impact forces. Some seats and restraint systems held, others gave way. Further evaluation is continuing.

A second crash test is being planned for late summer or fall to recheck some of the data and to cover some new areas of study. A Lockheed Constellation will be used.

The second test like the first will be at Deer Valley Airport, just north of Phoenix.

The surprising speed of the aircraft—20 mph faster than the planned speed of 140 mph—carried it 100 yards or more beyond the small hill at the end of the track along the airport runway. Most of the fuselage remained intact.

Interior motion picture cameras were not damaged and they allowed technicians to study the movement of the dummies. Top—The inflated air bag saved this "passenger" by holding him against his seat. Middle—These rearward-facing seats failed at impact, causing the dummies to slip out from their belts. They probably would not have survived. Bottom—The movie film showed that these occupants were severely jolted by the crash impact, but remained harnessed after the fuselage came to rest. They were judged to have been among the survivors.

HELICOPTERS WILL BE TESTED FOR USE IN FIGHTING AIRCRAFT FIRES

Helicopters and the latest ground fire-fighting equipment and techniques will be used during Federal Aviation Agency research and development tests this month when fire safety experiments begin at Atlantic City.

During the scientific experiments, five surplus USAF C-97 Stratocruiser aircraft will be burned. While the planes are burning, numerous associated tests will be conducted to evaluate the best methods of prolonging survival time in crashed aircraft that catch fire, and of suppressing the fire sufficiently to permit evacuation or rescue of the occupants.

Approximately 20 aviation fire safety research tests, sponsored jointly by the FAA and the Department of Defense, will be held at FAA's National Aviation Facilities Experimental Center (NAFEC) over a 30-day period.

Helicopter fire-fighting and rescue experiments will be run to test the effect of helicopter downwash in support of ground fire-fighting and rescue operations during fires that follow the crash of large aircraft.

The tests will help FAA and DOD (1) to determine the value of the helicopter when used alone, or with standard ground equipment for accidents occurring on or near an airport; (2) to make a comparative evaluation of the effectiveness of the helicopter as opposed to standard ground equipment; (3) to determine the comparative value of dry chemical and foam extingushing agents when used with the helicopter downwash, and (4) to evaluate airport fire-fighting equipment needed for various classes of airports.

The C-97 aircraft will be completely instrumented as a fire laboratory to study the hazards of fire in these simulated crash fires. While working under these controlled conditions, engineers will be able to study safer escape and rescue methods in aircraft accidents on and off the airport.

Instrumentation aboard the C-97s will be provided by the University of Dayton Research Institute under an FAA contract, and by the Technical Services Division of NAFEC.

The entire series of tests will be conducted on a newly-constructed fire pad, 200-feet in diameter, located northeast of NAFEC's 2-26 runway. The pad is saucer-shaped to allow the fuel not consumed in the fire tests to drain off into a tank and not soak into the ground and contaminate Atlantic City's water supply.

Conducted by FAA's Experimental Division, Systems Research and Development Service, the tests will be viewed by aviation fire safety experts from industry and government agencies, as well as by equipment manufacturers, airport managers and foreign aviation experts.

MILESTONES IN AVIATION

Four flying machines which led to an influential stream of aviation design were developed in 1908 by the Aerial Experiment Association. The organization was founded in Hammondsport, N. Y., by Alexander Graham Bell (of telephone fame), Glenn Curtiss and others. The planes built by the group featured characteristics derived from both the Wrights and the European airplane pioneers, the Voisin brothers.

All four biplanes had wings curved down toward one another in a slight double bow. Each had a forward elevator and a tail unit comprised of a tail plane and a vertical rudder, and was equipped with a Curtiss 40-h.p. engine.

The *White Wing*, above, designed by F. W. Baldwin, was fitted with four small ailerons outboard the wing tips—the first ailerons to be used outside of Europe.

Another plane, the *Red Wing*, was designed by Lt. Thomas Selfridge who later became the first fatality in powered flight while flying with Orville Wright who was seriously injured. The other two were the *Silver Dart*, designed by J. A. D. McCurdy, and Glenn Curtiss' *June Bug*.

The success of these aircraft led to another successful Curtiss plane in 1909.

Deadline for Federal Airport Fund Requests Set for July 3

Requests for federal assistance under the anticipated Federal Air Airport Program for Fiscal Year 1965 must be submitted by public agencies owning and operating airports by the July 3, 1964, deadline.

The objective of this program is to develop an adequate national system of airports by providing grants to local communities. Particular emphasis for the FY 1965 program will be given to the establishment of new airports in smaller communities for general aviation use and the improvement of existing airports.

NEW PUBLICATIONS AVAILABLE

The Federal Aviation Agency's Fifth Annual Report to the President and Congress, released in May, contains a full report of the activities of the Agency for the Fiscal Year 1963. Copies of the report may be purchased for 45 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402.

A new eight-page pamphlet, *Medical Facts for Pilots*, which highlights many aeromedical factors of interest to all who fly, is available free as long as the supply lasts. Write to the Director, Civil Aeromedical Research Institute, FAA Aeronautical Center, P.O. Box 1082, Oklahoma City, Okla., 73101.

FAA RECOUNTS STEPS TO BLOCK COCKPIT INVASION

The Federal Aviation Agency has taken a number of steps over the past three years to protect passengers aboard commercial airliners against violence, hijacking and other crimes.

■ On May 7, 1964, the FAA adopted a rule requiring that the cockpit doors on all airline and other commercial aircraft be kept locked in flight. The rule—which becomes effective on Aug. 6—is designed to keep potential hijackers and other unauthorized persons out of the cockpit where they might jeopardize the safety of flight.

Although the rule recognizes that locked cabin doors on airplanes will not necessarily provide "perfect protection," the agency does believe that the locking of the crew compartment door will often act as a deterrent to an unauthorized person who might otherwise attempt to enter the flight deck.

■ FAA also has a specially-trained group of "sky marshals" available for service aboard airline aircraft. These men are stationed at key points around the country and may be assigned to ride airline flights on request from the company management or the FBI. They were sworn in as Special U. S. Deputy Marshals by Attorney General Robert F. Kennedy in March 1962.

■ On July 28, 1961—four days after the hijacking of an Eastern Airlines Electra off the coast of Florida—FAA issued a Special Civil Air Regulation which prohibited interference with flight crewmembers in the performance of their duties and the carrying of concealed firearms by unauthorized persons aboard airline aircraft. The regulation subsequently was amended to include "unconcealed" as well as "concealed" weapons. Maximum civil penalty for violations was $1,000 for each offense.

■ In October 1961, the Agency asked the airlines to keep the cockpit door locked to prevent unauthorized persons from entering. The airlines also were given permission to provide side arms to properly-trained crewmembers and a $10,000 reward was offered through the Department of Justice for information leading to the arrest of potential hijackers.

■ Severe Federal penalties for the commission of certain crimes aboard aircraft were provided by Public Law 87-197, signed into law by President Kennedy in September 1961.

This law made aircraft piracy punishable by death under certain circumstances or "by imprisonment for not less than 20 years. . . ." Other sections made it a crime to assault, threaten, intimidate or interfere with flight-crew members and prohibited the carriage of concealed weapons by unauthorized persons The maximum penalty for carrying concealed weapons was a $1,000 fine or a year in prison or both.

■ Other actions taken by FAA include the adoption of two separate rules restricting the consumption of alcoholic beverages. The first became effective in March 1960 and prohibited passengers drinking from their own liquor supply. It also prohibited the airlines from serving any passenger who appeared to be intoxicated. The second rule required the airlines to deny boarding privileges to any person who appeared to be intoxicated.

■ FAA also issued a Notice of Proposed Rule Making last December requiring all large airline and other commercial aircraft to install a cockpit voice recorder. Such a device could give investigators a record of any cockpit incident as well as serve as a valuable aid in accident investigation.

Industry Joins Study of Arresting Gear Systems

Joint Federal Aviation Agency-industry study groups will meet this month to consider the problems involved in installing emergency aircraft arresting gear systems in major airports across the nation.

Three phases of the proposed system will be studied by the groups according to Cole Morrow, FAA's Director of Airports Service.

Studies will include the cost of modifying aircraft with an arresting hook and installing emergency arresting system equipment at airports, the evaluation of previous accidents and incidents in which such a system may have been helpful, and methods in which the system would enhance safety in the future.

The study groups were appointed following a meeting of representatives of the aviation industry and the FAA in Washington, D. C., May 7.

FAA tests have determined that a large airliner could be stopped by the arresting mechanism. In the tests, a hook mounted on the underside of the plane engaged a cable stretched across the runway. This system is similar to that used on aircraft carriers.

Janey B. Hart Heads 32-Woman Aviation Advisory Committee

Mrs. Janey B. Hart, right, noted pilot and wife of U. S. Senator Philip A. Hart of Mackinaw Island, Mich., heads the 32-member Federal Aviation Agency Women's Advisory Committee on aviation which met for the first time in Washington, D. C., last month.

Mrs. Jerrie Mock, left, of Columbus, Ohio, was named vice-chairman of the group by President Lyndon B. Johnson when he presented Mrs. Mock with the FAA Decoration for Exceptional Service for her historic 22,858-mile globe-spanning solo flight at the White House ceremonies last month.

Co-chairman of the committee is Miss Jean Ross Howard, assistant director of the Vertical Lift Aircraft Council, Aerospace Industries Association, and founder of the Whirly-Girls.

Nation's Aviation Mechanics Featured in Latest FAA Film

A 17-minute film depicting the importance of the aviation mechanics who service the nation's aircraft was premiered simultaneously in many cities throughout the country last month.

Titled *Aviation Mechanic*, the color motion picture portrays the vital importance of the work performed by airline and general aviation mechanics, as well as the technical training available to students.

The film is designed for the general public, and provides an insight into the varied skills and opportunities found in civil aviation today.

Submit requests to: Film Library, AC-43.1, Aeronautical Center, P. O. Box 1082, Oklahoma City, Okla., 73101.

A B-52 bomber flown by a Boeing test crew suffered serious damage to its tail structure after flying into severe air turbulence in a flight last January.

Severe air turbulence, one of the major unsolved aviation meteorological problems, is the object of an all-out research effort by the Federal Aviation Agency.

With the FAA serving as the focal point, knowledge bearing on severe air turbulence—from Government, air carriers, aeronautical manufacturers and pilots—has been organized to resolve the problem. Since 1959, the Agency has been exploring every facet of the turbulence problem as it specially applies to jet transports. It has initiated many research programs of its own, and has coordinated others with industry and other governmental agencies.

Although, statistically, jet encounters with severe or clear air turbulence have been relatively infrequent, FAA is deeply concerned with eliminating every possible risk. On more than 1.5 million jet flights over the most recent three-year period, 19 U. S. jets experienced accidents in which turbulence was considered a factor. Of this number, only four involved loss of aircraft control. Two of these were fatal accidents and the remainder were nonfatal.

Since U. S. air carrier jets began operating in the fall of 1958, there has been a total of 11 fatal accidents; four were crew training flights. Turbulence may have been a significant factor in two of the 11.

N. E. Halaby, Administrator of the FAA, has alerted the Agency's flight specialists to the seriousness of severe air turbulence even though jet encounters with the phenomenon have been infrequent.

"Although it could be considered a meteorological rarity when an airplane suddenly encounters violent turbulence, it still must be recognized as a threat to flight safety and its mysteries must be solved," the Administrator said.

To find the answers, Mr. Halaby ordered major research studies in these areas:

- Methods of detecting severe and clear air turbulence.
- A study of human factors to determine a pilot's ability to control his aircraft during severe turbulence.
- Aerodynamics, stability and control of airliners.
- Cockpit instrumentation.
- Weather.

FAA and NASA pilots, flying priority research missions, are making intentional jet flights into turbulent air to collect scientific data to be used to improve jet handling techniques.

Project TAPER, or turbulent air pilot environmental research, is sponsored jointly by both agencies as part of the over-all government-industry series of rough air studies.

During the first phase of TAPER, which began in May, the pilots flew a series of jet penetrations into turbulent air masses in an FAA Convair 880 and participated in flight simulator tests.

The flights were conducted from FAA's Aeronautical Center in Oklahoma City. Data obtained from the flights was used in the flight simulator at NASA's Ames Research Center, Moffett Field, Calif., to study pilot reactions and to explore areas not possible in actual flight.

After completing a review of both the flight tests and simulator studies, the second phase of the project using an FAA Boeing 720 will resume this month. Data obtained from earlier NASA wind tunnel tests on Boeing jet horizontal tail surfaces will be correlated in this series. A third phase will be run only if additional studies are required.

During the jet penetration flights, instruments record airspeed, altitude, acceleration, angular velocity, roll and yaw, and camera photograph cockpit flight instruments.

The first phase of a human factors study at the Naval Aeromedical Acceleration Laboratory, Johnsville, Pa., has been completed by the FAA's Office of Aviation Medicine.

Using a human in a centrifuge to simulate the gyrations

FAA COMBATS TURBULENCE

Most of the vertical stabilizer was gone when plane landed.

of a jetliner in severe turbulence, 11 volunteer airline and FAA pilots participated.

Although the reports are still being evaluated, Dr. Charles R. Harper, project officer of the FAA study, said that preliminary findings indicate that jet pilots would benefit from training in a turbulence simulator.

A vigorous educational program by the FAA to acquaint jet airline pilots with the nature of severe air turbulence, and how to fly when it is encountered, is nearly 90 per cent complete. Starting with an indoctrination of pilots in methods of high altitude operations, the FAA program was gradually expanded to include jet operations in areas of turbulence.

FAA field inspectors, who regularly monitor airline pilot operations, were instructed to re-emphasize turbulence penetration procedures and high altitude operations during proficiency check rides and on pilot certification flight tests. At the Agency's request, affected airlines amended their pilot training programs by including turbulent air flight techniques in the pilot curriculum.

At Northwest Airlines, Captain Paul Soderlind, manager of operations research and development, initiated a lecture program for pilots which thoroughly analyzed high altitude operations of swept-wing turbojets. It covered the analysis of recent turbulence accidents and incidents, described the buffet boundaries of jet aircraft, and discussed recommended turbulent air pentration procedure.

In November 1963, FAA officials attended a Soderlind presentation in Minneapolis. Following the presentation, the FAA ordered all its own jet specialists to attend a special turbulence course which was held in December at FAA's Aeronautical Center in Oklahoma City. The FAA jet specialists then returned to their posts to spread the information to airline pilots in their regions. Mr. Soderlind himself also delivered the presentation to personnel of other airlines. Since that time, each airline has adopted similar turbulent air presentations.

Augmenting this presentation, which has now become an integral part of all airline refresher courses and pilot training, was another FAA action. The three jet airplane manufacturers, Boeing, Douglas, and Convair, upon recommendation of the FAA, revised their airplane flight manuals to include recommended procedures when flying their aircraft in turbulent air. These recommended procedures stressed attitude flying, that is, keeping the airplane level, in trim and flying at constant power. This procedure allowed a pilot to penetrate turbulence at higher speeds and thus at a safer control level.

FAA has pointed out that pilots should not be reluctant to penetrate turbulence with the autopilot on. In such cases, however, the attitude-hold should be in the "off" position. And the pitch trim activity should be monitored. The autopilot can always be disengaged if the pilot, in his judgment, thinks it is warranted. Pilots were reminded that the autopilot is not affected by the instrument display but by actual conditions.

In another area, the National Aeronautics and Space Administration has completed for the FAA and the Civil Aeronautics Board a full-scale wind-tunnel test of a Boeing 720 horizontal tail section. Preliminary data reports are now being evaluated by the FAA to determine whether or not a design modification is needed on the aircraft.

Another project at the FAA Air Academy in Oklahoma City is seeking possible improvements or new designs in gyro attitude instruments which would make them more readable and more useful to the pilot when an airplane is experiencing severe turbulence, or during periods of upset. The project, which involves in-flight evaluations of most of the commonly used attitude indicators, is being coordinated

An FAA Convair 880 jet was flown through rough air by FAA and NASA pilots probing the upper air masses during the joint Project TAPER.

with CAB, NASA, aircraft manufacturers and airline operators.

In April 1964, FAA conducted a symposium in Oklahoma City for the purpose of exchanging information with various segments of the industry interested in the instrument problems. Members of the Air Line Pilots Association, instrument manufacturers, air carriers, airplane manufacturers, and FAA engineering and operations personnel attended. These studies are expected to lead to establishment of appropriate technical standard orders in the areas of instrument reliability, etc. In this connection, most of the major carriers have undertaken a program to improve the readability of the attitude instruments currently in use.

In addition, FAA has begun studies to determine the feasibility and practicability of providing pilots with visual or oral warning devices to alert them that their trim position is beyond acceptable limits. The aircraft companies already have warning devices indicating to the pilot when his trim position is outside acceptable limits for takeoff. The feasibility of extending this warning capability to cover in-flight configurations as well, is presently under study. Consideration is also being given to expanding its use to cover all turbojet transports where such a problem exists.

Studies over the last few years offer the best answer to turbulence: *Avoid it when possible*. But because some forms of turbulence conceal their whereabouts, a major goal is to develop a means of detection—on the ground and in the air.

Clear air turbulence—CAT—presents one of the greatest problems. No tell-tale clouds are present to warn the pilot. He is in the CAT before he can take any corrective measures.

To provide for a safe and smooth flight through the higher altitudes where CAT is generally encountered, the development of practical turbulence sensors or detectors—both airborne and on the ground—has been advised by Weather Bureau researchers. Several possibilities have been proposed to provide direct detection and measurement of the actual turbulence of the air. These techniques include: use of conventional and modified radar; use of lasers (a light beam a million times more powerful than a flashlight beam which utilizes a light beam in somewhat the same way that radar uses radio waves); both direct and indirect temperature measurements; the measurement of anomalous or irregular propagation of light; measurement of sound and radio waves through turbulent layers; the measurement of the variation in the electric field, and stellar scintillation measurements (the measurement of the difference in star twinkling). Other suggestions include the development and use of a simple turbulence sensor to be used with balloons or rockets. Work on the detection device program is being done by FAA in conjunction with NASA, the Defense Department, the Weather Bureau, the airlines and private industry.

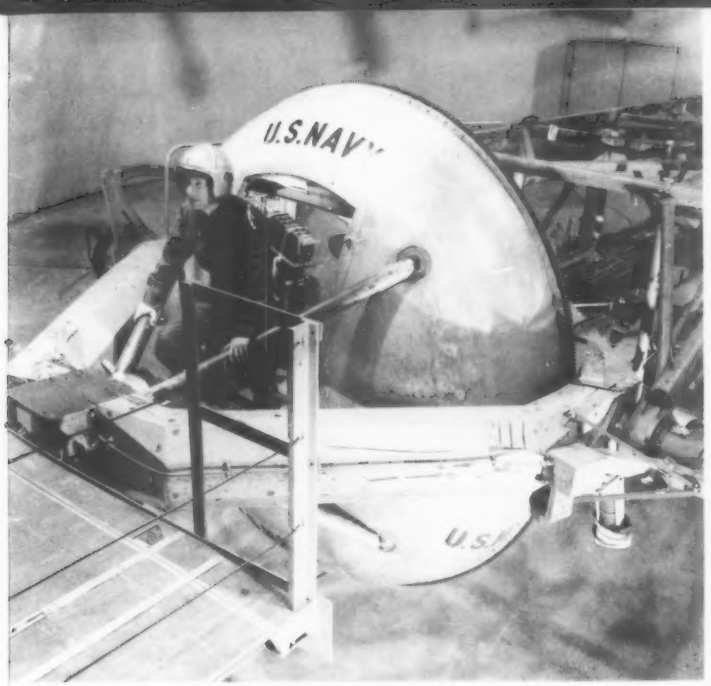
A separate Weather Bureau-Eastern Air Lines study has been examining the effects of the changes in air temperatures surrounding an aircraft in flight as another means of detecting the presence of CAT.

CAT is such an enigma to both airmen and meteorologists that precise definition is difficult. Generally, CAT is moderate to severe turbulence which occurs above 15,000 feet in clear air. It is very patchy and transitory in nature. The dimensions of these turbulence patches are quite variable but seem to average about 2,000 feet in depth, 20 miles in width, and 50 or more in length. The patches elongate in the direction of the wind. It is more prevalent during the winter months from January through March. In forecastings, it is difficult to pinpoint the location of CAT areas because of the limited and scattered nature of upper air data.

Zones of high-level, clear air turbulence are usually associated with mountain waves (winds that assume a forceful upward movement because of mountainous terrain) and/or coincident areas of strong horizontal and vertical wind shears. The intensity of the turbulence varies with the strength of each wave or shear.

CAT forecasts of limited scope have been issued by the National Meteorological Center at Suitland, Md. Because of inadequate weather data, areas of moderate or greater turbulence can only be noted generally.

In another area, a broad study is under way to gather information from pilots who experience upset while flying in severe air turbulence. Because pilots may have been reluctant to give full information about upsets directly to



Gyrations caused by severe turbulence were simulated in the centrifuge.

the FAA, the Flight Safety Foundation is soliciting anonymous reports from pilots under an Agency contract.

Another FAA project is scheduled to begin late this year at the Washington Air Route Traffic Control Center at Leesburg, Va., and at Washington National Airport. A Weather Bureau meteorologist working at Washington National Airport will compile threatening weather data from weather radar returns and from available weather information. His interpretation of area weather hazards will be plotted on a weather display and transmitted directly to the controller's radar scope at the Center. This information will indicate the type of hazard, its vertical extent, the velocity, and any additional data which will help the FAA air traffic controller safely vector terminal and en route air traffic around areas of hazardous weather.

In another test program, preparations are already under way to remote Weather Bureau radar presentations directly to the IFR room where the information will be displayed on special radar scopes to assist controllers as they route air traffic.

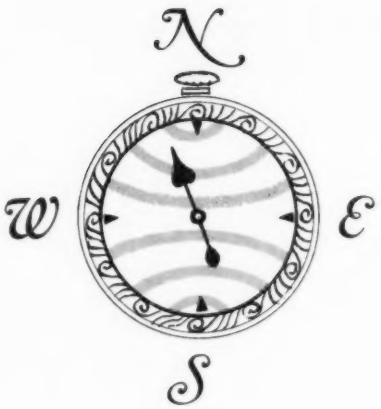
Nineteen locations are scheduled to participate in the program which began in May.

Much of the knowledge about the structure and formation of severe storms and associated turbulence has been obtained from research flight penetrations into the storms. This has been augmented by special air and surface weather observations. Many have been conducted by the Air Force, the Navy, NASA and the Weather Bureau.

Studies of conventional thunderstorms by the Weather Bureau have produced successful operational forecasting techniques. The Weather Bureau's Severe Local Storms Center at Kansas City, Mo., now issues warnings outlining the general areas of tornadoes, severe thunderstorms and squall lines. The National Meteorological Center issues "advisories" on thunderstorm activity four times daily on its high-level significant weather prognostic charts.

Although turbulence within a thunderstorm can be violent, it can be avoided because it can be detected visually by its cloud systems. In addition, ground and airborne radar help pinpoint the precipitation associated with these storms.

Top: Centrifuge and observation tower are prepared for turbulence tests: Center: FAA doctors, Charles R. Harper *(left)* and Federal Air Surgeon M. S. White *(right)*, prepare FAA pilot J. A. Ferrarese for his test in the centrifuge. Above: Another FAA pilot, R. S. Sliff, one of 11 pilots in the tests, is debriefed after a "flight."



This is the third of a series of articles on aerial navigation.

Man, unlike his feathered friends, does not have any built-in directional indicators to give him the means to determine direction of flight. Because he lacks this natural instinct for direction, and lacks judgment to sense speed and height while flying in the atmosphere, he must rely on navigational instruments.

With reliable instruments, a pilot is able to navigate safely from one place to another. Some of the basic instruments available to a pilot are:

- Compass—magnetic and nonmagnetic (gyro)
- Altimeter
- Airspeed indicator
- Free air thermometer
- Aircraft clock

Knowing the capabilities and limitations of these instruments, a pilot is able to use them effectively to determine his direction, his altitude, the free air temperature and the speed of the airplane.

Although modern science has provided many navigational instruments, such as the radio altimeter, the gyro fluxgate compass, loran, shoran, etc., this article covers only the basic instruments normally found in general aviation aircraft.

The magnetic compass is the most important.

Although magnetic characteristics were discovered many centuries ago, the first practical magnetic compasses did not come into use until the late 19th Century. Since that time, many improvements have been made to aid the traveler.

Man's answer to his directional deficiency, the magnetic compass, tells him the direction in which the airplane is headed. The heading is the angle measured clockwise from north to the forward end of the airplane's longitudinal axis.

Two causes are given for magnetic compass errors. One is referred to as *variation.* This error must be corrected. Error is introduced into the compass because the needle doesn't point to true north, which is the reference for measuring direction. Instead, the needle points to the magnetic pole which in the northern hemisphere is located on Bathhurst Island, approximately 76° North Latitude and 156° West Longitude. Variation is the difference between true north and the direction indicated by the compass.

Variation corrections can be determined by referring to an aeronautical chart. These are indicated as East or West variation correction. If West variation, it is added to the intended heading. If East variation it is subtracted from the heading.

Deviation occurs when the compass is disturbed by magnetic fields created by metals and electric systems within the aircraft. Deviation error in an airplane can be determined by swinging the compass of an airplane. This can be done in the air or on the ground, depending upon the availability of equipment.

Generally, for most general aviation pilots swinging the aircraft compass on the ground over a compass rose is the simplest method.

To swing the compass on the ground, the airplane is placed on a magnetic compass rose, the engine started, and electrical devices normally used (such as radio) are turned on. (Tailwheel-types of airplanes will have to be jacked up into flying position.) The plane is aligned with magnetic north indicated on the compass rose and the reading shown on the airplane compass is recorded. The plane is then rotated through each 30 degrees and each reading is recorded. If the airplane is to be flown at night, the lights are turned on and any significant changes in the readings are noted.

In addition, the pilot can make a rough check of his compass every time he lines up on a runway where the direction is known.

In addition to variation and deviation, other compass errors such as northerly turning error, speed error, heeling error, swirl error and yaw error are introduced into the magnetic compass by the motion of the aircraft itself.

Since the magnetic compass is not a perfect instrument, subject to a number of forces which cause erroneous readings, some characteristics are worth remembering. They include:

- If the aircraft is on a northerly heading and a turn is made toward east or west, the indication of the compass lags, or momentarily indicates a turn in the opposite direction *(northerly turning error).*
- If the aircraft is on a southerly heading and a turn is made, the compass needle will indicate a greater amount of turn than is actually made *(turning error).*
- If the aircraft is on an east or west heading, no error is apparent while entering a turn to north or south.
- If the aircraft is on an east or west heading, a decrease

NAVIGATIONAL INSTRUMENTS

Deviation is found by "swinging the compass" on the ground.

in airspeed causes the compass to indicate a turn to the south *(speed error)*.

■ If the aircraft is on a north or south heading, no error is apparent while climbing, diving or changing airspeed.

Heeling error is caused when an aircraft flying straight but in a banked attitude changes position with respect to the compass magnets. **Swirl error** may occur when the liquid within the compass case is set in motion during a turn, and **yaw error** may occur if a multi-engined aircraft is yawing about its vertical axis due to a difference in power settings of the engines.

Reading the compass only when the airplane is flying straight and level at a constant speed will reduce errors to the minimum.

To offset some of the errors in the magnetic compass system, the gyrocompass was developed to provide a more reliable and more universal directional device. It is used to measure the magnitude of turns, as an aid in holding a constant heading, and, after it has been reset in reference to the magnetic compass, as the primary directional guide in making instrument approaches and letdowns.

Two other important navigational instruments, the altimeter and the airspeed indicator, are a part of the Pitot-static system of the airplane. A third instrument, a vertical speed indicator which records the rate of climb also operates from this system.

The altimeter measures the height of the aircraft above a given point. Like other instruments in the airplane, to use it effectively a pilot should understand the principle of its operation and the effect of barometric pressure and temperature upon it.

The altimeter is an aneroid barometer, registering atmospheric pressure on a scale calibrated in terms of altitude instead of inches of mercury. Since air is more dense at the surface of the earth than aloft, as altitude increases, the atmospheric pressure decreases. This difference in pressure at various levels causes the altimeter to indicate changes in altitude.

Effects of atmosphere pressure and temperature upon the standard condition 29.92 inches of mercury at a temperature of +15 degrees Centigrade are:

Pressure changes. When flying from an area of relatively high atmospheric pressure into one of lower pressure, the true altitude (actual height of the aircraft above sea level), corresponding to a given indicated altitude, will decrease. Conversely, when flying from low to higher temperatures, it will increase.

Temperature changes. When flying from an area of relatively high temperature into one of lower temperature, the true altitude, corresponding to a given indicated altitude, will decrease. And conversely, when flying from low to higher temperature, it will increase.

Federal Aviation Regulations require that the altimeter *shall be set to the most recent altimeter setting of a station along the route of flight.*

If there is no such station, the latest altimeter setting of an appropriate available station shall be used. In an aircraft having no radio, the altimeter shall be set to the elevation of the departure airport.

The airspeed indicator measures the speed of an aircraft through the airspace. Actually, it is a sensitive, differential pressure gauge which measures and shows promptly the difference between (1) Pitot, or impact pressure, and (2) static pressure, the undisturbed atmospheric pressure at flight level. These two pressures will be equal when the aircraft is parked on the ground in calm air. When the aircraft moves through the air, the pressure on the Pitot line becomes greater than the pressure in the static lines. This difference in pressure is registered by the airspeed pointer on the face of the instrument, which is calibrated to give the pilot his airspeed in miles per hour, or knots, or both.

Three types of airspeed of interest to a pilot are (1) indicated airspeed (IAS), the direct reading from the airspeed indicator which is uncorrected for variations in atmospheric density, installation error and instrument error, (2) calibrated airspeed (CAS), which is IAS corrected for installation and instrument error, (3) true airspeed (TAS), which is IAS or CAS corrected for temperature and altitude. TAS can be worked out on a navigation computer by (1) setting the pressure altitude against the outside air temperature on the airspeed computation scale window, (2) referring to the CAS airspeed on the minutes scale and (3) reading the TAS on the miles scale.

Other useful navigational instuments are the free air thermometer and the aircraft clock.

A thorough understanding of all the basic navigation instruments will provide the pilot with necessary aids he needs.

SAFETY FIRST

Over-Water Flying

A flight over the waters of a rippling azure lake is a breathtaking scene. But because flying over water can be dangerous, a pilot should have a thorough knowledge of the possible hazards and be prepared to meet them.

The hazards that cause the most trouble for pilots over or near large bodies of water are those involving poor visibility. With little or no warning, an off-shore wind brings with it poor visibility which can place the pilot in a precarious position. He might be unable to make his way back to shore, if flying in a landplane, or be unable to reach a sheltered spot for landing on the water, if flying a seaplane.

Flying over large bodies of water when visibility is poor may cause considerable confusion because of the lack of a horizon. When flying near such large water areas as the Chesapeake Bay, Delaware Bay, Long Island Sound and the Great Lakes, unless weather conditions are ideal, it is wise to circumnavigate the water areas. If you must fly over water, even in good weather, it is better to fly a route which intercepts the paths of boats operating in the waterways. Then if an emergency ditching becomes necessary, a pilot can set his plane down near a passing vessel.

Another hazard along coastal areas is fog. Layers of fog will often lie in a straight-line just offshore. Within a few minutes, fog can move inland covering a wide area. Because fog can easily and quickly cover the seaside airport where a pilot planned to land, it is advisable to have an alternate airport in mind.

On the west coast it is a good idea to plan your arrivals near the noon hour or during the early afternoon to arrive under VFR conditions. Coastal fog, common in that area, usually burns off by late morning and moves in again late in the afternoon. If weather sequence reports indicate a fog bank or stratus cloud layer to the west of your intended destination, the field could "sock in" quickly. An alternate airport farther inland and out of the fog area should be considered.

Inasmuch as poor visibility or mechanical difficulties can result in a forced landing or ditching in the water, a pilot should take special precautions. Some over-water safety suggestions are:

- File a flight plan. If a pilot's intended route is over water, he can indicate it in detail so the U. S. Coast Guard and Civil Air Patrol can be alerted in cases of emergency ditching.
- Maintain radio contact while flying over water. As an added safety measure, a pilot should keep in touch with the nearest radio communications station so immediate aid can be provided in an emergency.
- Carry sufficient over-water survival equipment. If a pilot must fly over large bodies of water at altitudes which would not permit making a safe landing on shore, he should be equipped with proper flotation equipment.

Pilots who make infrequent trips can rent the equipment from most airplane supply houses. Pilots operating regularly over or near water should equip their planes with proper survival equipment. Depending on individual needs, the pilot can obtain such equipment as life vests (such as the Mae West), a raft, visual and/or audible signalling devices, dye markers and food.

Despite all precautions, it may sometimes be necessary to ditch an airplane. The pilot should retract his landing gear and glide his plane into a smooth area without hitting the wing tips. If the water is so smooth that it has a glassy appearance, it may be difficult to estimate altitude.

To ditch an airplane with a fixed landing gear, it is recommended that the plane be landed in a slow, full stall. It should touch water in a tail down position to help eliminate the risk of nosing over when the wheels strike the water surface. If ditching near land, it is advisable to land parallel and close to the shore line when possible.

In coastal or water areas, the seaplane has an almost endless landing area. However, landing on choppy waters stirred up by bad weather or high winds can be hazardous. Sheltered waters offer the pilot the best landing area.

Letters

FAA

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

● Surplus Military Aircraft

If a P-51 can be operated without a camera installation, why does a T-28 need a camera installation?

Does the FAA ground all T-28s or is there a distinction made between the T-28A with an R-1300 engine and the T-28B with an R-1820 engine?

Don G. McHenry
Ypsilanti, Mich.

A P-51 and a T-28 are certificated differently. The P-51 is certificated in the limited category, CAR, *Part 9, and can be used in any type of operation not for compensation or hire. On the other hand, the T-28 is certificated in the restricted category,* CAR, *Part 8, which requires that it be used only for some special purpose such as aerial photography.*

The FAA does not ground all T-28s. The T-28A with the R-1300 engine is eligible for certification in the restricted category only. The T-28B (North American NA-260) is eligible for certification in the standard category (CAR, *Part 3). These aircraft were modified by the manufacturer in order to meet the standard category airworthiness requirements.*

● Instrument Approach Minimums

Most flying schools and instructors say that it is illegal to attempt to make an instrument approach when the weather is reported below minimums. However, a recent magazine article states that "the commencement of an approach when the weather is below minimums might be all right if the approach terrain contains no hazards such as dwellings or other such obstructions, and only one approach is made."

If it is the intent of the FAA that no approach may be attempted any time the weather is reported below the minimums, why can't the FAA come up with a statement such as: "No person operating an aircraft may commence a standard instrument approach procedure prescribed in Part 97 (New), unless weather conditions are at or above the landing weather minimums prescribed in that part for the procedure used." I substituted the word "commence" instead of the words, "land that aircraft," as presently written in the new Part 91.117 (C) of the new FAR's.

Wray A. Clark
Kansas City, Kan.

The magazine article appears to have left you with the impression that an instrument approach may not be commenced when the weather is reported to be below minimums. This is not the case.

Federal Aviation Regulations, *Part 91.117, points out that when an instrument letdown to an airport is necessary, the pilot shall use a standard instrument approach procedure prescribed for the airport. As you know, such procedure prescribes the minimum weather conditions below which pilots may not land. These weather minimums are intended to serve as the general standard which establishes the necessary level of safety. As a practical matter, pilots do not generally begin an instrument approach when the weather is reported to be below the prescribed landing minimums.*

The determination and reporting of weather in aviation is not as precise and accurate a science as we would like it to be. Therefore, we strive in the regulations to take into account the shortcomings of weather reporting and the integrity of the pilot. There are instances when pilots should be permitted to "take a look," and you will find that FAR 91.117 (b) permits this. You will note that, in addition to authorization and criteria for approach below landing minimums, this section provides authorization and criteria for landing.

A pilot, therefore, has a right to commence an approach. He may also execute a landing, if, upon reaching the authorized minimum altitude, conditions are found to be equal to or better than the prescribed weather minimums. However, a violation report would still be filed against the pilot if the Agency had evidence that the reported weather accurateiy portrayed existing conditions as being below minimum. The pilot would still have the right to attempt to disprove the accusation with evidence that the necessary weather conditions did exist.

The determination as to whether a violation of FAR 91.117 had occurred would apply regardless of the existence of hazards, such as dwellings or other obstructions, in the vicinity of the airport. Likewise, the determination as to whether a violation of FAR 91.9, "Careless or reckless operation," had occurred in conjunction with a violation of FAR 91.117, is a decision which would be based on the particular circumstances of each case.

● Aircraft at National Parks

Why do Federal Air Regulations prohibit aircraft from landing in all but one or two of our National Parks? It seems to me that these would be very desirable places in which to have landing strips, yet our laws limit this opportunity. Please tell me why?

Frank Stone
Hermiston, Ore.

The rules which prohibit aircraft operations at these locations are regulations of the Department of Interior's National Park Service, and not the Federal Aviation Agency. National Park Service officials in Washington have advised FAA that it is their desire to provide landing facilities in conjunction with the park system under their jurisdiction where it is feasible or practical to do so. They have already done so at Mount McKinley, Death Valley, Glacier Bay, Grand Teton, Katmai, Fort Jefferson, Isle Royale, and Kitty Hawk. Some other park areas are served by adequate landing facilities within a reasonable distance.

There are some 200 sites for which the National Park Service is responsible. Many of them have terrain features which would not only make airport construction extremely difficult and expensive, but operations would be extremely hazardous.

Additional information regarding the operation of aircraft into National Park Service areas may be obtained from the National Park Service.

● Foreign Certificates

Can a temporary 90-day certificate to fly in the Caribbean area as a private pilot be validated for commercial use? Can this license be granted for a year or renewed after the 90-day expiration date? Also, does the FAR say that if a U.S.A. registered aircraft is flown outside the United States proper, one may fly with any foreign certificate? If a pilot with a private license rents an aircraft and takes friends for a trip, can these friends help share the expenses of the rental? What requirements does a Canadian pilot with a commercial license need to obtain a U. S. commercial license?

Seymour Green
Toronto, Ontario

A Special Purpose Pilot Certificate is normally issued for a 12-month period and is renewable each year. It may be issued for limited commercial privileges only, such as for ferrying U. S. registered airplanes within the U. S. to ports of export by foreign pilots, but not to operate a charter service.

With the exception of certain operations, such as air carrier operations which are conducted under an operating certificate issued by the United States, our regulations do not stipulate what pilot certificate is required for operating U. S. registered aircraft outside the United States. The country over which such aircraft are flown governs such pilot certificate requirements.

A private pilot and his friends may share expenses in the instance you describe, subject to the regulations of the country over which the plane is operated.

You may obtain a U. S. commercial pilot certificate by meeting the requirements of FAR, Part 61, Sections 61.111, 61.113, 61.115, and successfully passing the flight test prescribed in Section 61.117.

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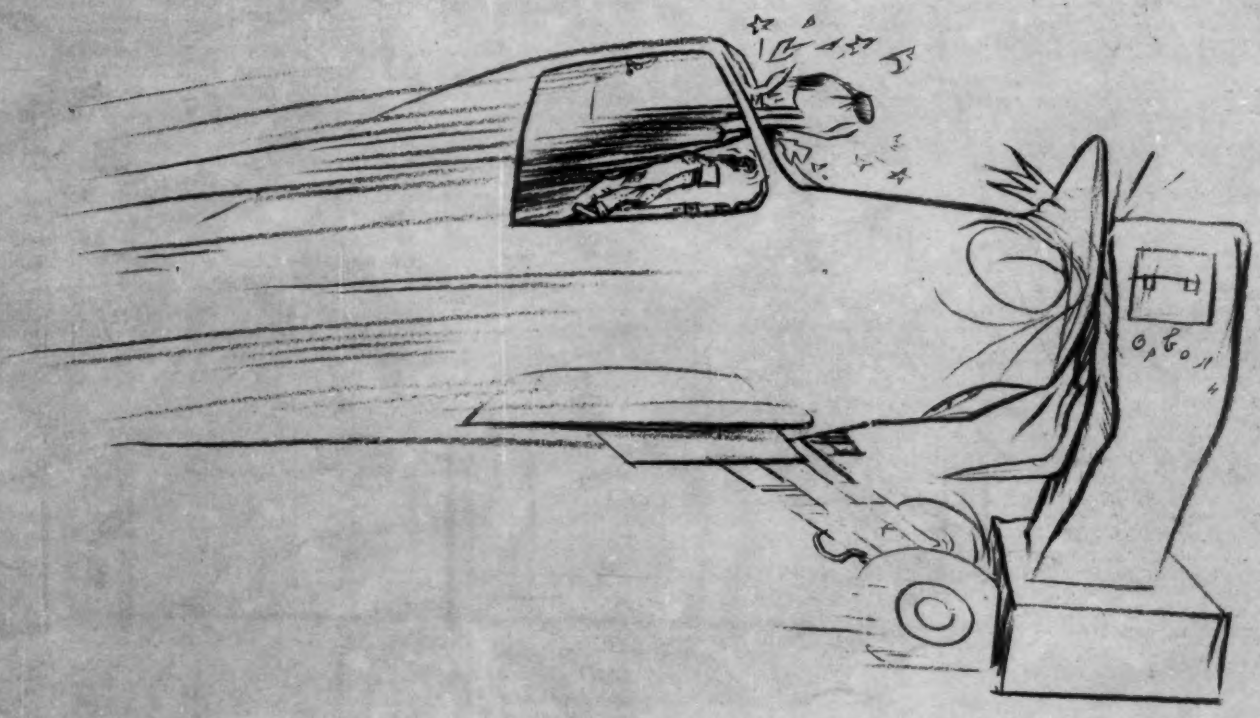
Why get bumped or bounced or jolted?



Keep your seat belt firmly bolted.